700 MHz Public Safety Broadband Network, Multi-Vendor Interoperability
March 17, 2011

Dr. Gregory Henderson
Director Broadband Products
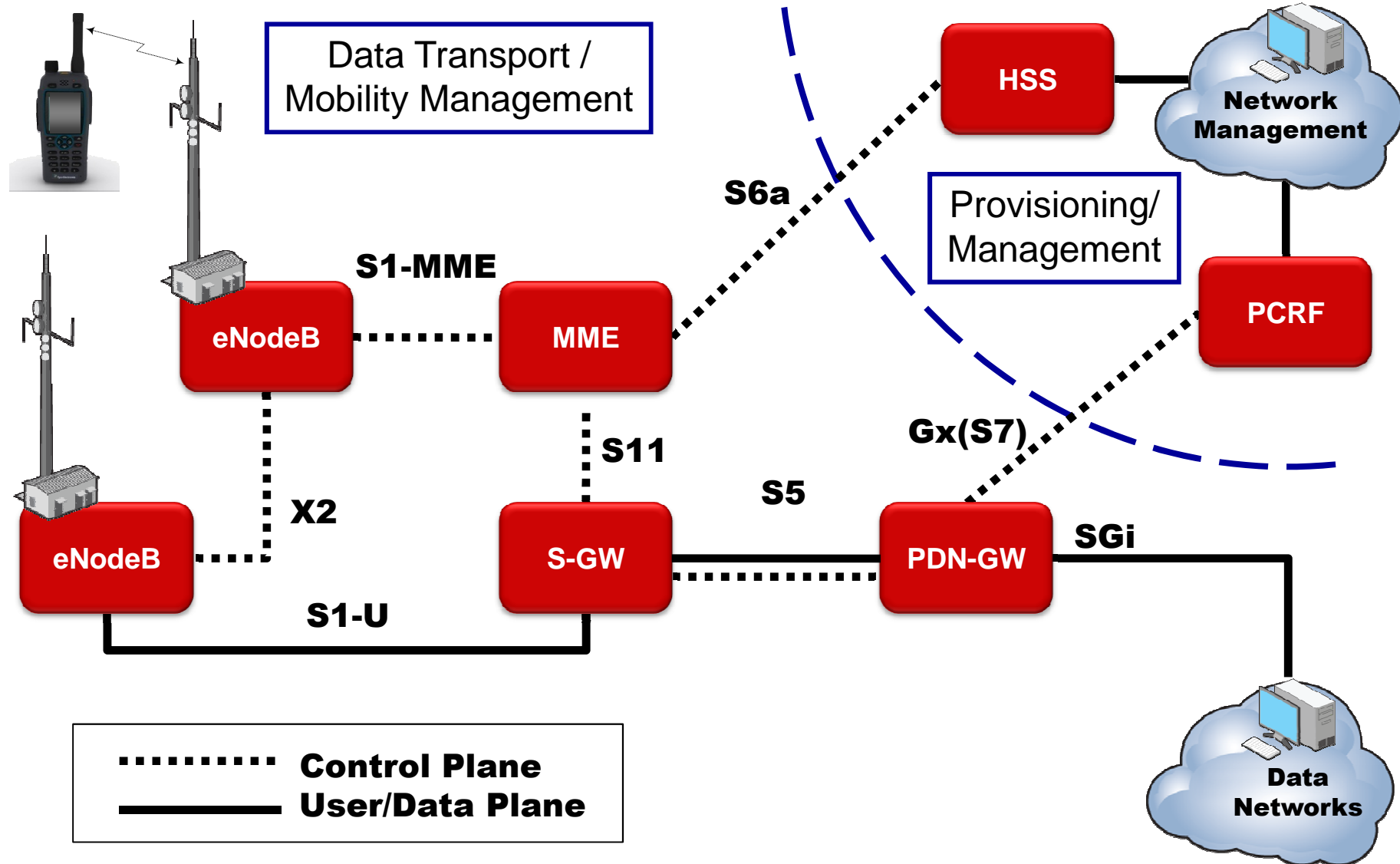Public Safety and Professional Communications
Harris Corporation

HARRIS®
assured**communications**®

Agenda

HARRIS

- Concept Network Architecture

- Interoperability/Standards

*assured*communications™

Typical LTE Core Network

HARRIS

Data Transport /
Mobility Management

Provisioning/
Management

HSS

Network Management

S6a

PCRF

S1-MME

eNodeB

MME

Gx(S7)

S11

X2

S5

eNodeB

S-GW

PDN-GW

SGi

S1-U

···· **Control Plane**

—— **User/Data Plane**

Data Networks
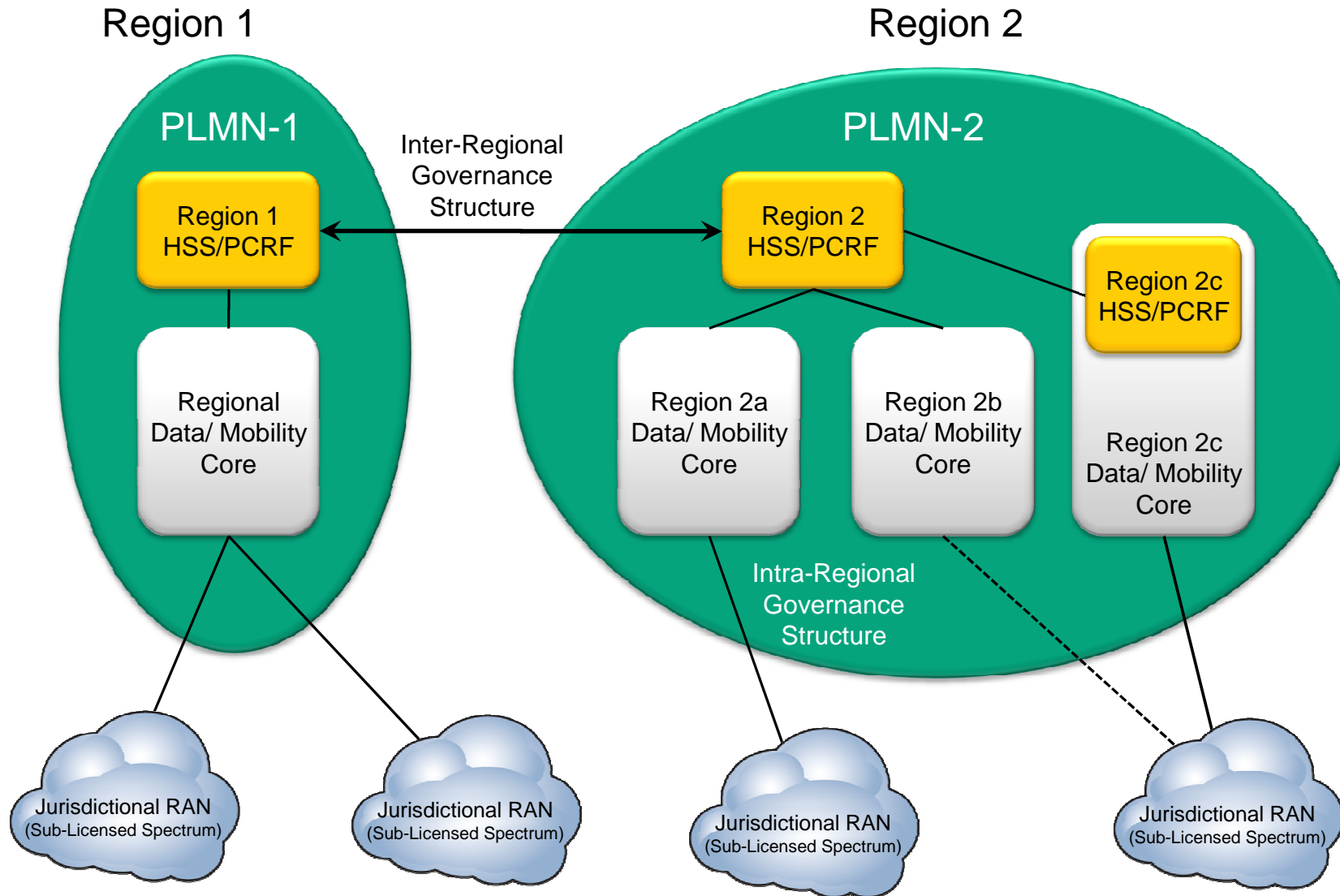
*assured*communications™

High-level View of the LTE Core

HARRIS

- "Provisioning and Management"
  - Elements: HSS and PCRF
  - Contains user profiles, authentication information, etc.
  - Contains information to setup user bearers
  - Requires centralized management for roaming (nation-wide interoperability)

- "Data Plane/Mobility Management"
  - Elements: MME, S-GW, PDN-GW
  - Backhaul considerations drive proximity to RAN and distributed deployment decisions
  - User plane high bandwidth requirements: 50-100Mbps/site
  - User mobility management
  - Often best geographically distributed throughout the network

assuredcommunications™

Network Architecture

HARRIS

- Harris believes that effective and scalable nation-wide interoperability can be achieved through a multiplicity of Regional Core Networks

- A national PLMN ID should be assigned for nationwide roaming

- Regional Provisioning Core
  - Option 1: A PLMN ID can be assigned to each regional core
  - Option 2: Regional cores identified by subscriber location function (SLF)

- Sub-Regional Networks should be assigned IMSI subsets within the regional core to which they are aggregated

- Regional cores may be assigned by a number of alternatives (State, Major Economic Areas, Regional Planning Boundaries, etc.)

*assured*communications™

Notional Architecture

HARRIS

Region 1

Region 2

PLMN-1

PLMN-2

Inter-Regional Governance Structure

Region 1 HSS/PCRF

Region 2 HSS/PCRF

Region 2c HSS/PCRF

Regional Data/ Mobility Core

Region 2a Data/ Mobility Core

Region 2b Data/ Mobility Core

Region 2c Data/ Mobility Core

Intra-Regional Governance Structure

Jurisdictional RAN (Sub-Licensed Spectrum)

Jurisdictional RAN (Sub-Licensed Spectrum)

Jurisdictional RAN (Sub-Licensed Spectrum)

Jurisdictional RAN (Sub-Licensed Spectrum)

*assured*communications™

Nationwide Roaming

HARRIS

- The nationwide PLMN ID provides roaming for all users within a defined set of roles and responsibilities

- Roaming agreements between Regional Core Networks can be established by their respective governing bodies
    - Adds differentiation to nationwide roaming if desired

- Border regions may have more comprehensive agreements and policies due to a more frequent occurrence of roaming incidents

*assured***communications**™

Considerations for Regional Core

HARRIS

- Each region can define an architecture for the "Regional Core"
- Each region requires a single "Master" HSS
- The core can be distributed:
  - Region can contain many S-GW, PDN-GW, and MME
  - Region MAY choose to have distributed local HSS for sub-region traffic
    - Must "roll up" to the "Master" HSS
- Some regions may choose to have a single core for the whole region
- The "Master" HSS contains information about other core elements for each user (i.e. PDN-GW)
- Regional cores can be privately owned by Public Safety jurisdictions or commercial entities (e.g. cellular operator, hosting partners, etc.)

*assured*communications™

Advantages of Distributed Network

HARRIS

- ## Regional Flexibility
  - – Many business models available

- ## Tractable User Configuration/Management
  - – User profiles defined locally
  - – Each "Region" defines best architecture

- ## Distributed Data Core
  - – Local traffic stays local

- ## Redundant/Distributed Network
  - – No single point of failure

- ## Standardized Nationwide Roaming/Performance

assuredcommunications™

Agenda

HARRIS

- Concept Network Architecture

- Interoperability/Standards

*assured*communications™

Interoperability

HARRIS

- NPSTC, PSST, etc. endorsed the selection of LTE because of its inherent interoperability characteristics
  - All interfaces and functions are implemented as defined by 3GPP
- Commercial operators use components from multiple vendors in their networks today
- The use of equipment from multiple vendors…
  - Enables fair competition
  - Promotes innovation in the market place
  - Promotes innovation in the user space

*assured*communications™

3GPP Areas of Currently Defined Interoperability

HARRIS

- Network Identification

- Roaming

- Admission Control

- Priority Access

- Security

- Performance

- Reliability

- Capacity

- Coverage

*assured*communications™

System Profiles/Conformance

HARRIS

- Each release of LTE contains many features and capabilities
  - Vendors may implement different features (or not)
  - Interoperability requires defined tests/procedures

- Harris supports the formation of LTE Public Safety System Profiles associated with current and future LTE releases
  - These system profiles should be created in an ANSI recognized standards body
  - Profiles can be created for "standard" public safety roaming features
    - For example: QoS/Priority for roaming fire user
  - Interoperability testing procedures for profile validation should also be defined in ANSI standards body

*assured***communications**™

Interoperability Testing

HARRIS

- Core network elements
  - Multi-vendor IOT is performed today in operator labs
  - "Public Safety" test bed [e.g. PSCR Demonstration Network] is required to validate profiles/procedures as defined by standards process

- User devices
  - IOT testing profiles are being created by PCS Type Certification Review Board (PTCRB)
  - NIST/PSCR participated in the creation of the band 14 profile in PTCRB
  - PTCRB can be used for User Device validation

*assured*communications™

Summary

HARRIS

- ## Network architecture
  - Regional distributed network
  - Nationwide roaming PLMN ID and framework

- ## Interoperability
  - ANSI standards body for creation of:
    - Public Safety LTE system Profiles
    - Public Safety LTE test procedures
  - Standardized interoperability testing/verification
    - PTCRB
    - NIST PSCR Lab

*assured*communications™